International Journal of Pediatric Otorhinolaryngology 114 (2018) 120–123

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Teaching a tracheotomy handoff tool to pediatric first responders

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ARTICLE INFO

Presented as podium presentation at the American Academy of Otolaryngology Head and Neck Surgery Annual Meeting (2015) and as a poster presentation at the American Academy of Otolaryngology Head and Neck Surgery Annual Meeting (2014).

Keywords:
handoff tool
Tracheostomy complication
Connecticut airway risk evaluation
Critical airway risk evaluation

ABSTRACT

Introduction: The Critical Airway Risk Evaluation (CARE) system is an airway classification system we designed to improve handoffs between caregivers by describing the risk of a patient's airway above the tracheotomy tube, and therefore the correct resuscitation maneuvers in the event of an airway emergency. It is designed to quickly communicate 3 categories: 1-easily intubatable; 2-intubatable with specialized techniques or equipment; or 3-not intubatable. We have demonstrated previously that the system is easily taught to and used by pediatric otolaryngologists. For this system to be useful, it must be usable by a broader group, including first responders to a tracheostomy related airway emergency. The objective of this study is to analyze the reliability of teaching and ease of learning the CARE system among practicing otolaryngologists, otolaryngology residents, and pediatric residents.

Methods: A brief tutorial was designed to introduce the scale and was presented to practicing otolaryngologists, otolaryngology residents, and pediatrics residents. A 30-point questionnaire was administered in which patient's airways and airway management techniques were described. Participants were asked to classify each example according to the CARE system. Statistical analysis was performed using Student's *t*-test and Fleiss' kappa reliability.

Results: A total of 66 physicians participated in the study. The pediatric residents correctly identified the patients' airway class 89% of the time (26.6/30 ± SD = 2.9). Otolaryngology attendings and residents answered correctly 92% of the time (27.7/30 ± SD = 2.9), which was not statistically different ($p = 0.23$). Inter-rater reliability was also substantial among all groups, with a Fleiss' kappa greater than 0.7 for all groups.

Conclusions: This study demonstrates that the system can be taught to pediatrics residents as effectively as it can be taught to otolaryngology residents and practicing otolaryngologists and, therefore, can be effectively utilized in inter-disciplinary handoffs to facilitate information transfer to potential first responders.

1. Introduction

From an airway point of view, patients with a tracheostomy have chronic vulnerability. In the event of accidental decannulation where immediate recannulation cannot be performed, an emergency response is necessary. During the post-operative healing period, before the stoma matures, recannulation after accidental decannulation can be very difficult and there may be a need for immediate ventilation without the tracheostomy as an option. The vulnerability persists after the post-operative period because on rare occasions, even a longstanding and well healed stoma may not allow immediate replacement of the tube. Patients with normal airways above the trach site, i.e. normal mouth opening, normal larynx, normal subglottis, may either breathe spontaneously or be easily resuscitated using standard orotracheal intubation. However, many patients who have a tracheostomy placed have abnormal airways, and thus they may require special maneuvers for successful intubation. Some may be only intubatable under the most ideal circumstances by a team with specialized equipment and some may not be orotracheally intubatable under any circumstances. Patients who are dependent on mechanical ventilation would be at more risk.

Information about the airway above the trach tube would be critical to know for first responders to a tracheostomy emergency. This would

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https://doi.org/10.1016/j.ijporl.2018.08.003
Received 2 June 2018; Received in revised form 3 August 2018; Accepted 3 August 2018
Available online 07 August 2018

avoid wasted time on a resuscitation maneuver that would be destined to fail. To further increase the vulnerability of this population, these patients often have complex multisystem medical conditions, and undergo multiple transitions of care from the operating room, to the intensive care unit, to the floor, and finally to home. During a transition of care, airway resuscitation information may get lost among other critical body system information. For these reasons, we felt this population was in need of a clear and concise communication tool for airway resuscitation information during a handoff.

Handoffs are a timely topic: over the past 10 years, the Joint Commission (JC) has targeted transitions of care, and specifically handoffs, as an area of particular vulnerability in medicine as a whole [1]. In 2012, the JC promoted a specific set of "solutions tools" for handoffs using the acronym SHARE which can be summarized as: **S**tandardize critical content, **H**ardwire tools into the hospital system, **A**llow opportunities to ask questions, **R**einforce quality, and **E**ducate successful handover technique [2]. Implementation of these tools have shown valuable results in medicine in general [3,4] as well as many specific fields including surgery, critical care, and pediatrics [5–7].

In 2014, we developed and published a simple classification system, the Connecticut Airway Risk Evaluation (CARE) which separates trach patients into categories describing their ability to be intubated: Class 1 is easily intubatable with standard equipment, Class 2 is intubatable only with specialized equipment or skills, and Class 3 is not intubatable. The designation "v" is added to describe whether or not a patient is ventilator dependent [8]. We have since changed the name from "Connecticut" to "Critical" to more accurately describe our intent and to allow for generalization at other institutions while keeping the acronym the same. Development of the CARE classification system is an application of the JC's SHARE concept. Our intent in developing this system was to apply this to each and every patient with a tracheotomy, thereby streamlining the handoff between providers and giving a clear and concise description of the best chance of successfully managing a tracheotomy patient's airway in the case of tracheotomy tube failure. We have previously shown that this system has a high interrater reliability among attending pediatric otolaryngologists [8].

For this system to be useful for patient care, it must be easily applied by first responders to a tracheostomy related airway emergency; realistically, an attending pediatric otolaryngologist is unlikely to be that first responder. In a tertiary pediatric hospital, pediatrics residents may be responsible for airway management until more experienced help arrives. Therefore, in this study, we evaluate the ability to teach and apply the CARE system among two groups: otolaryngologists, including residents, and pediatrics residents.

2. Methods

This study was approved by the Connecticut Children's Medical Center Institutional Review Board. The need for patient or participant consent was waived.

A tutorial was designed to teach the CARE system to participants. This brief PowerPoint presentation included information on anatomy, tracheotomy tubes, and the CARE system classification (Table 1) by presenting patient scenarios and clinical characteristics which define the categories, including photos of the view afforded upon intubation attempts. Class 1 was described as "normal" meaning that the patient may have been undergoing the trach for prolonged ventilation purposes and the airway was easily exposed with a standard laryngoscope with passage of an age appropriate tube (Fig. 1). We defined "standard laryngoscope" as one which would be found in every anesthesia cart or code cart-i.e. a conventional intubating laryngoscope with Mac or Miller blade which is age appropriate. Class 2 was described as needing special maneuvers or equipment (such as a video laryngoscope, rigid telescope or flexible bronchoscope) or modifications (such as a smaller endotracheal tube) to achieve intubation (Fig. 2). Thus, the Class 2 patient requires equipment that would not be widely available in every anesthesia/code cart, or requires an endotracheal tube that would not be chosen based on patient age. So, intubating a Class 2 child successfully requires special equipment, special skills, or special knowledge of that patient's anatomy. Examples of Class 2 include a child with 60% subglottic stenosis who requires a tube that is 2 sizes smaller than one would guess for the age, or a child with Robin sequence who can be intubated only with a video laryngoscope but not with a standard laryngoscope. Class 3 was described as a child who is simply not intubatable above the tracheotomy tube, and would be applied to a newborn with high grade 3 congenital subglottic stenosis who underwent emergent tracheotomy in the first 24 h of life, for example (Fig. 3). A "v" is added to the designation if the patient is currently ventilator dependent (see Table 1).

Table 1
CARE descriptions.

Category:	Description of Intubation:
Class 1	Easily intubated without special instrumentation or modifications
Class 2	Intubatable only using special instrumentation (such as a video laryngoscope, rigid telescope or flexible bronchoscope) or modifications (such as a smaller endotracheal tube)
Class 3	Not intubatable despite using special instrumentation or modifications

The designation "v" is added to any class to describe that the patient is ventilator dependent.

Immediately after participants learned the classification system, they filled out a 30 item questionnaire with descriptions of tracheotomized patients' airways and intubation or airway management techniques. Each question stem described the intubation technique or description of bronchoscopy, laryngoscopy, or flexible fiberoptic laryngoscopy findings of a patient undergoing a tracheotomy for various indications. Some stems included photographs. As an example, a Class 3 question stem is, "A neonate presents in respiratory distress. Bronchoscopy reveals 95% congenital subglottic stenosis and the patient cannot be intubated. Emergent tracheotomy is performed under mask ventilation. How would you classify this patient's airway?" These questions had been previously studied and found to have high reliability amongst attending pediatric otolaryngologists [8].

3. Results

A total of 66 physicians completed questionnaires. There were 51 pediatrics residents and 15 otolaryngologists (9 attendings and 6 residents). The otolaryngologists were tested together, prior to the pediatricians. Answers were tabulated using Microsoft Excel and compared using the student's t-test.

Results are presented in Table 2. The otolaryngologists demonstrated overall substantial agreement with a Fleiss' kappa = 0.780. For attending physicians, the inter-rater reliability was also substantial with kappa = 0.700. Resident physicians demonstrated an interrater reliability with near perfect agreement (kappa = 0.926). The pediatrics residents also showed substantial agreement (kappa = 0.658).

Overall, the pediatrics residents correctly applied the CARE classification system to an average of 26.6 (+/-SD 2.9) of 30 patient descriptions. The otolaryngologists correctly applied the CARE classification system to an average of 27.7 (+/-SD 2.9) of 30 descriptions. Both groups did well and the rate of correct answers between groups was not statistically significant ($p = 0.23$).

4. Discussion

Building reliable handoff procedures and fostering a culture of safety are of the utmost importance. Pediatric patients with a tracheotomy are particularly vulnerable to transitions in care due to their medical complexity and their potential for life-threatening events due